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A survey of *Pulex irritans* (Linnaeus 1758, Siphonaptera: Pulicidae) infestation in sheep and residential areas in Kurdistan Province, Iran

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Abstract

Fleas are the most common and important external parasites worldwide and also serves as vectors of various pathogens for humans and animals. The study aimed to determine the prevalence of *Pulex irritants* in sheep herds and residential areas of villages in Kurdsitan Province, Iran. A total of 2,900 sheep were randomly selected from 48 flocks and 630 residential areas of 18 villages from November 2011 to October 2012. The collected fleas were identified by key fleas. Results revealed that 259 (8.93%) sheep from 31 flocks (65.51%) and 31 (4.92%) residential areas were infested with *P. irritants*. Of 1323 *P. irritants*, 503/1323 (38.02%) and 820/1323 (61.98%) were male and female, respectively. Of these, 950 (72%) were from animals and 373 (28%) were from residential areas. The highest infection rate was found in age group less than one year (30.93%, 29/92). The body distribution of all collected flea was found to be from back part of the body (100%). Seasonal distribution of *P. irritants* in examined animals had significant difference. Geographical distribution of *P. irritants* indicated that the highest infection rate was found in Marab region (6.03%). The highest flea infestation was also found in summer (41.8%) with a total number of 450 fleas out of 1323 (34.01%). From the results of this study, it was concluded that *P. irritants* was a prevalent flea in sheep and residential areas in the region and may serve as an important vector for pathogenic agents.

Keywords: *Pulex irritants*, Sheep, Kurdistan province, Iran

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Introduction

Flea is an insect belonging to order Siponaptera, which bite and blood feed on mammals and birds (Khoobdel *et al*., 2012). Of all 2,574 species and subspecies of flea (16 families and 238 genuses) only a few numbers of them have symbiosis and synatropic relationship with human and animals (Lewis, 1999). Fleas are arthropods widely distributed worldwide because of close contact with pets, livestock, humans and also wild animals and birds. The studies on fleas started from 50 years ago and recently a few reports from different parts of the country, i.e. Kermanshah and Lorestan Provinces in west, Hormozgan Province in south, Tehran in central part and Kohgiluyeh and Boyer-Ahmad Province Province in sought west have been published in which different spices of flea were reported (Shayan and Rafinejad, 2006, Telmadarraiy *et al*., 2007, Kia *et al*., 2009, Tajedin *et al*., 2009, Khoobdel *et al*., 2012). Fleas' fauna and ecology related to natural habitats of Plague diseases were considered and many species of fleas were reported in Kurdistan Province, Iran (Klein *et al*., 1963, Farrhang-Azad, 1973). According to the Iranian Veterinary Organization in 2008, an average population of 52 million sheep was distributed in Iran. The Kurdistan Province has approximately 2.42% of these sheep. This study was carried out to determine the existence of *P. irritants*, geographic and seasonal distribution in farms and villages of the region.

Materials and methods

Forty five flocks including 2,900 cross-breeds and indigenous sheep were randomly selected using a random number table from November 2011 to October 2012. The specimens were collected from 26 farms and 26 residential areas of 18 villages. The area had been previously divided into four sub-areas. In each sub-area, sheep to be tested were randomly selected and examined. The animals were divided into four age groups on the basis of eruption of permanent incisor teeth (Smallwood, 1992) (Table 1). Data pertaining to each examined flock (flock location, management system, time of day, tag number, breed) were collected and recorded. The flocks examined were raised following traditional husbandry practices, with animals grazing during the day.

Fleas were collected from the body of the animals using different methods: flay paper, manually from human cloths, insecticide, light trapping. Fleas were placed into 70% ethanol in labeled glass vials until they were processed for identification. Fleas' numbers and data pertaining to the predilection sites of the hard fleas were recorded separately. Management practices followed age and sex of the animals; and recent use of acaricides were also recorded. All collected fleas became transparent in *Potassium hydroxide* 10% overnight at room temperature. The fleas were incubated serially in ethanol 30%, 50%, 70%, 80%, and 95% for about 15–20 min. The dehydrated fleas were remained in Ethanol-Xylol solution for 1h, xylol overnight, and Lactophenol for 24hrs (Durden *et al*., 2005). All specimens were identified by morphological characteristics Farhang-Azad (1973) and Asmar *et al*. (1979).

Statistical evaluation

The non-parametric Chi-square (χ^2) test was used for evaluating statistical associations between obtained data using the SPSS statistical program (version 14, SPSS Inc., Chicago, IL, USA). A $p \leq 0.05$ was regarded as significant with confidence intervals of 95%.

Results

Flea infestations were found in the sub-areas of Kurdistan Province and on the animals investigated during the course of the study (Table 1). Of all animals, 259/2900 (8.93%) from 31 flocks (65.51%) and 31 (4.92%) residential areas in villages were infested with a total number of 1323 fleas. All

Table1. The prevalence and geographic distribution of Pulex irritans in animals and residential areas in Kurdistan villages, Iran (n= 2900).

Villages	No. of sample			Prevalence (*n/N*, %)		
	Human residential areas	Flocks	Sheep	Human residential areas	Infested flocks	Infested sheep
Ch	80	3	258	10 (8)	50	13.64 (35)
Ya	80	6	173	0	20	3.48 (6)
Gb	80	2	167	0	100	4.17 (7)
Bs	26	3	150	8.33 (2)	50	2.21 (3)
Md	50	2	163	2.04 (1)	100	8.70 (14)
Ml	25	2	178	4.17 (1)	100	13.64 (24)
Sm	50	1	108	2.04 (3)	100	1.50 (2)
Ga	45	2	180	6.67 (3)	100	7.14 (13)
Ma	20	3	412	1.76 (1)	50	13.64 (56)
Pl	40	4	210	5 (2)	100	3.81 (8)
Tk	50	6	155	2.04 (1)	20	4.28 (7)
Ls	30	2	123	0	100	3.87 (5)
Ak	6	1	89	20 (1)	100	4.17 (4)
Dv	25	3	107	25 (6)	50	3.09 (3)
Mo	3	2	136	0	100	25 (34)
Bu	1	1	120	0	0	0
Ya	3	2	79	0	100	11.11 (9)
Ta	15	3	92	15 (2)	50	30.93 (29)
Total	630	48	2900	4.92 (31)	65.51 (31)	8.93 (259)

Notes: Ak Alak Kohneh, Bs Bard Sepi, Bu Buvanah, Ch Chatan, Dv Daravayan, Ga Gar Abad, Gb Gazan Bozorg, Ls Lon Sadat, Ma Marab, Md Maein Dol, Ml Malakshan, Mo Morvarid, *n* animals infested with ticks, *N* total animals examined, Pl Palangan, Sm Shn-o-mel, Ta Tavankesh, Tk Tilako, Ya Yakhtakhan, Yu Yunes Abad

collected fleas were *P. irritants* (61.98% female and 38.02% male) belonging to family Pulicidae of which 950 (72%) and 373 (28%) were respectively from animals and residential areas. Geographical distribution of *P. irritants* indicated that the highest infection rate was found in Marab region (6.03%). *Pulex irritants* infestation from examined sheep of central part was not significantly higher than other parts of the province (χ^2 = 2.15, p > 0.05) (Table 2).

The infestation rate was 30.93% (29/92) for animals less than one year-olds (Table 2). The flea indices (number of fleas per infested animals) were 0.6. The highest flea attachment was found on back part of the body (100%, 1323/1323). At least eight fleas were found in most infested sheep. However, the most abundance was in summer (July–September) (41.8%, 1212/2900) with a total number of 450 fleas out of 1323 (34.01%) (Fig. 1). Seasonal distribution of *P. irritants* infestation had significant difference (χ^2 = 14.25, p < 0.05).

Table 2. Prevalence of flea infestation according to the age groups and sex of examined sheep in villages in Kurdsitan Province, Iran.

Examined animals	No. of examined animals	Prevalence (n/N, %)	Age (year, %)				Sex (%)	
			<1	1-2	3-4	>4	M	F
Ch	258	13.64	13.64	0	0	0	51.32	48.68
Ya	173	3.48	3.48	0	0	0	57.5	42.5
Gb	167	4.17	26.06	0	0	0	47.96	52.04
Bs	150	2.21	2.21	0	0	0	45,25	54.75
Md	163	8.70	8.70	0	0	0	45.98	54.02
Ml	178	13.64	13.64	0	0	0	51.32	48.68
Sm	108	1.50	1.50	0	0	0	53.33	46.67
Ga	180	7.14	7.14	0	0	0	56.02	43.98
Ma	412	13.64	13.64	0	0	0	51.32	48.68
Pl	210	3.81	3.81	0	0	0	52.49	47.51
Tk	155	4.28	4.28	0	0	0	46.73	53.27
Ls	123	3.87	3.87	0	0	0	51.68	48.32
Ak	89	4.17	4.17	0	0	0	47.96	52.04
Dv	107	3.09	3.09	0	0	0	61.8	38.2
Mo	136	25	25	0	0	0	50	50
Bu	120	0	0	0	0	0	0	0
Ya	79	11.11	11.11	0	0	0	54	46
Ta	92	30.93	30.93	0	0	0	48.5	51.5
Total	2900	8.93	8.93	0	0	0	45.54	54.46

Notes: F, femalel; M, male; n, animals infested with fleas; N, total animals examined.

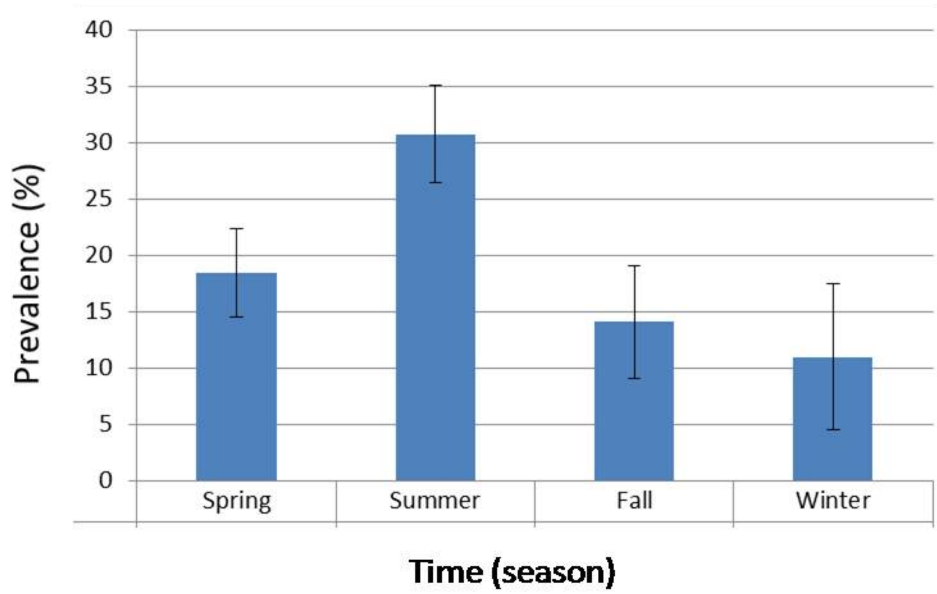


Figure1. Seasonal distribution of *Pulex irritance* infestation in sheep and humans residential areas in villages of Kurdistan Province, Iran.

Discussion

This specie, *P. irritants* is the only genus in Iran which is the most common flea attacking humans and animals (Farrhang-Azad, 1972, Asmar, 1979). Hadadzadeh and Sheikh Abbasi (2000) reported that the spreading and intensity of *P. irritants* in c*hicken farms mother* hen in suburban of Tehran, capital of Iran was notable. The number of flea per chicken was 4–5 and farm workers had developed skin lesions. In another investigation, seven species including *P.*

irritans were reported from Chaharmahal-o-Bakhtirary Province in southwest Iran (Khoobdel *et al*., 2012).

Pulex irritans, *Ctenocephalides canis* and *C. felis felis* were reported in sheep, cattle, goats, poultry, and humans with the highest prevalence of *P. irritans* (91%) in East Azarbaijan Province, North West Iran (Garedaghi, 2011). In earlier study, *P. irritans*, *Xenopsylla cheopis*, and *Nosopsylla* spp. were reported in rodents of Kermanshah Province, West Iran (Telmadarraiy *et al*., 2007). *Pulex irritans* and *C. canis* were two common fleas in farm animals of Libya (Kaal *et al*., 2006).

In the present study, *P. irritans* infestation occurred over all seasons of the entire year in the region with the highest infestation rate in summer. It is in accordance with other investigations (Fagbemi, 1982, Durden *et al*., 2005, Beck et al., 2006, Christodoulopoulos et al., 2006, Gracia *et al*., 2008, Khoobdel *et al*., 2012) who reported flea infestation throughout the year with a high prevalence in the summer**.** It may be due to suitable temperature range in the region for the activity, growth, development and reproduction of fleas (Cornwell, 1974, Dryden, 1993). Since, in studied year, the weather condition was much better in spring (March–June) and summer (July–September) comparing to the other seasons, particularly, in central part of the region. In addition, animal farms and villages were crowded in this part of the province which was also suitable for flea existence. In other words, temperature in the studied year provided the outdoor environmental conditions suitable for flea development. According to Harwood and James (1979) and Silvermann and Rust (1983), decreasing in temperature with increasing humidity are suitable condition which directly affects prevalence of *P. irritans*. However, *P. irritans* may have adapted to a higher preferable temperature in this region (Christodoulopoulos *et al*., 2006). Furthermore the practice of allowing manure to accumulate in animal houses results in increased warmth and humidity, which favors the propagation of fleas (Obasaju and Otesile, 1980).

The highest prevalence of *P. irritans* infestation was recorded in younger sheep (<1 year-olds). This finding is similar to the results of previous surveys (Fagbemi, 1982, Yeruham *et al*., 1989, Franc *et al*., 1998, Christodoulopoulos *et al*., 2006, Rinaldi *et al*., 2006, Garcia *et al*., 2008). It is possible that young animals have a thinner skin predisposing them to higher *P. irritans* infestation than others. The results could be attributed to less attention of farmers towards younger animals to flea infestation, intensive livestock husbandry practices, and close contact of infested sheep with other animals, and the consequent availability of both hosts to flea (Kalkofen and Greenberg, 1974). This is in line with Kaal *et al*. (2006) and Iqbal *et al*. (2012) who reported better hygiene management prevented the build up flea infestation in farms practicing semi-intensive management system as compared to those having intensive systems. Most of the *P. irritans* in this study infested back site with longer hair coat. Rinaldi *et al*. (2006) also reported that the back and the abdomen are the heaviest infested zones of body to flea aggregation. The highest *P. irritans* infestation on back may be due to the fact that *P. irritans* prefer warm, moist and hidden sites in thin skin with a good vascular supply. According to Yeruham *et al*. (1996) and Biu *et al*. (2010), immunological factors, skin odour or skin quality influences flea infestation.

It was concluded that *P. irritans* infestation was prevalent in sheep and residential areas in villages of western Iran and need more investigations about role of *P. irritans* in the epidemiology of flea-borne diseases.

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توزیع فصلی و جغرافیایی کک پولکس ایریتانس (لینه ۱۷۵۸، سیفوناپترا: پولیسیده) در گوسفندان و اماکن انسانی روستاهای استان کردستان در غرب ایران

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چکیده

کک انگل خارجی شایع و با اهمیت در دنیا بوده و ناقل عوامل بیماری زا به انسان و حیوانات محسوب می گردند. این مطالعه برای تعیین فراوانی، توزیع فصلی و جغرافیایی *پولکس ایریتانس* در گوسفندان و اماکن روستایی غرب ایران انجام شد. از ۲۹۰۰ راس گوسفند در ۴۸ گله گوسفند و ۶۳۰ مکان روستایی ۱۸ روستای استان کردستان در فصول مختلف ۱۳۹۱-۱۳۹۰ نمونه برداری تصادفی ساده شد. کک ها جمع آوری شده با استفاده از کلید تشخیص کک ها شناسایی شدند. نتایج نشان داد که ۲۵۹ راس گوسفند (۸/۹۳درصد) از ۳۱ گله (۶۵/۵۱) و ۳۱ (۴/۹۲درصد) محل زندگی روستائیان آلوده به کک *پولکس ایریتانس* بودند. از۱۳۲۳ کک *پولکس ایریتانس*، ۸۲۰/۱۳۲۳ (۶۱/۹۸درصد) کک ماده و ۵۰۳ /۱۳۲۳ کک نر (۳۸/۰۲ درصد) بودند. از این تعداد کک *پولکس ایریتانس*، تعداد ۹۵۰ (۷۲درصد) عدد از کک های صید شده مربوط به دام های آلوده و ۳۷۳ (۲۸درصد) عدد مربوط به اماکن انسانی بودند. بیشترین فراوانی آلودگی در گوسفندان جوان زیر یک سال (۳۱/۹۳درصد) بود. توزیع بدنی کک ها در گوسفندان از ناحیه پشتی (۱۰۰درصد) بود. توزیع جغرافیایی گوسفندان آلوده به کک *پولکس ایریتانس* نشان داد که بیشترین فراوانی آلودگی از منطقه ماراب (۶/۰۳درصد) بود. بیشترین کک جدا شده نیز در فصل تابستان (۴۱/۸درصد) به تعداد ۴۵۰ عدد (۳۴/۰۱درصد) بود. توزیع فصلی آلودگی گوسفندان به کک *پولکس ایریتانس* اختلاف معنی داری داشت. نتایج مطالعه حاضر نشان داد که کک *پولکس ایریتانس* در گوسفندان و اماکن انسانی منطقه شایع بوده و امکان دارد به عنوان ناقل با اهمیتی در انتقال عوامل بیماری زا درمنطقه مطرح باشد.

واژگان کلیدی: *پولکس ایریتانس*، گوسفند، استان کردستان، ایران